The purpose of the correct electrical systems malfunctions lesson is to provide you with the skills and knowledge required to properly diagnose, troubleshoot, repair and maintain any electrical system in the automotive field. You, as a mechanic, must have a basic knowledge and understanding of electricity to perform these tasks effectively in a

Action: Correct electrical system malfunctions

Condition: In a classroom, and at a training site, given items of construction equipment, student guide, wiring schematics, electrical components, batteries, personal protective equipment (PPE), duo-check, battery carts, Test Measurement and Diagnostic Equipment (TMDE), technical manuals (TM's) applicable to each item of equipment, special tools, and standard shop equipment.

Standards: Perform the following in accordance with (IAW) technical manuals (TMs) applicable to each item of equipment, without damage to equipment or the environment, and without injury to personnel:

1. Identify the fundamentals of automotive electricity.
2. Interpret wiring schematics / Identify the purpose of a battery, battery components, maintenance, safety and environmental procedures.
3. Identify TMDE used for electrical system testing / troubleshooting logic tree.
4. Use TMDE to perform diagnostic tests on items of construction equipment with electrical system malfunctions.
5. Identify starting system components, functions, and common faults.

Safety Requirements	Risk of skin and eye injury exist during battery testing and charging procedures along with connecting and disconnecting test equipment to the batteries. The possibility of electrolyte burns and electrical shock also exists. You will wear safety goggles, rubber gloves, and apron when handling or performing tests on lead acid batteries. In case of skin or eye contact with electrolyte, a shower or eyewash will be used. All jewelry of any kind (ID tags, watches, rings, etc) will be removed. You will be provided and required to wear aural protectors while equipment is running.
Risk Assessment Level	Low
Environmental Considerations	Lead acid batteries and electrolyte can be hazardous to the environment if not disposed of properly. There is a potential for battery acid spillage during battery testing and charging procedures. The possibility exists for spillage of fuel, oil, and antifreeze during engine operations. Adequate ventilation is required during engine operations and when battery load testing and charging procedures are being performed. Comply with Shop/Installation SOP/Operations order requirements for disposal of hazardous materials.

ACTION: IDENTIFY THE FUNDAMENTALS OF AUTOMOTIVE ELECTRICITY

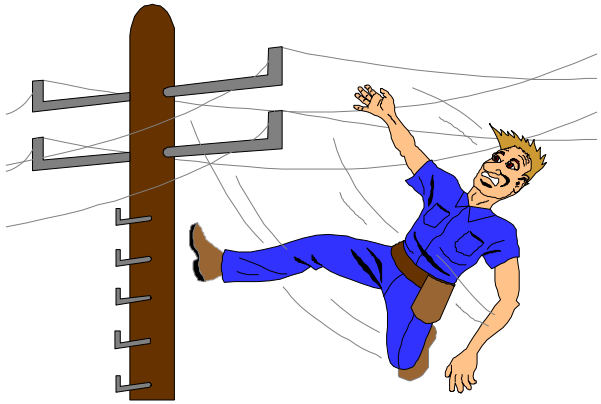
CONDITIONS: IN A CLASSROOM, GIVEN A STUDY GUIDE

STANDARDS: IDENTIFY THE FUNDAMENTALS OF AUTOMOTIVE ELECTRICITY IN ACORDANCE WITH (IAW) FM 11-60 AND TM 9-8000

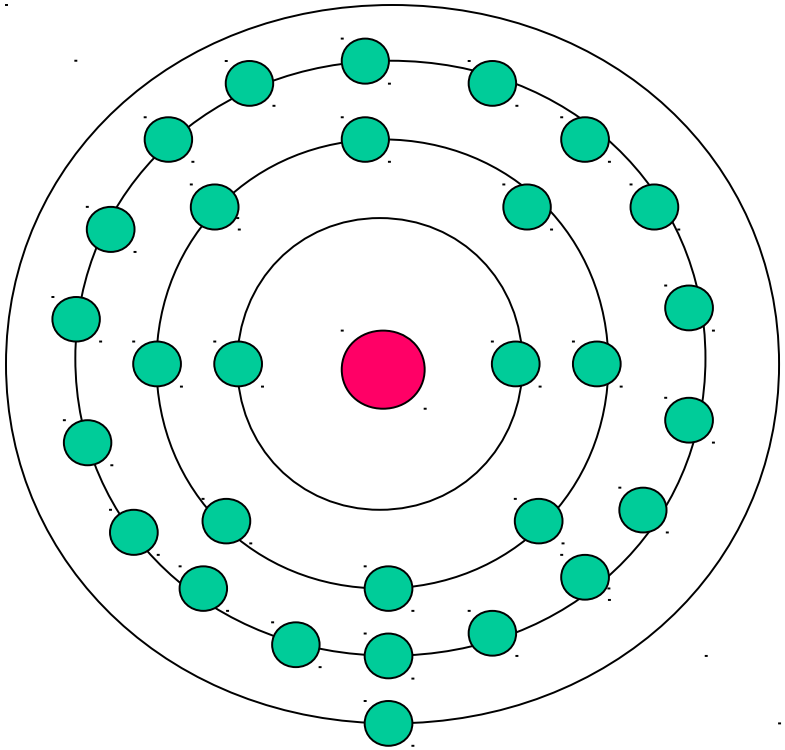
SAFETY: NONE

RISK ASSESSMENT: LOW

ENVIRONMENTAL: NONE

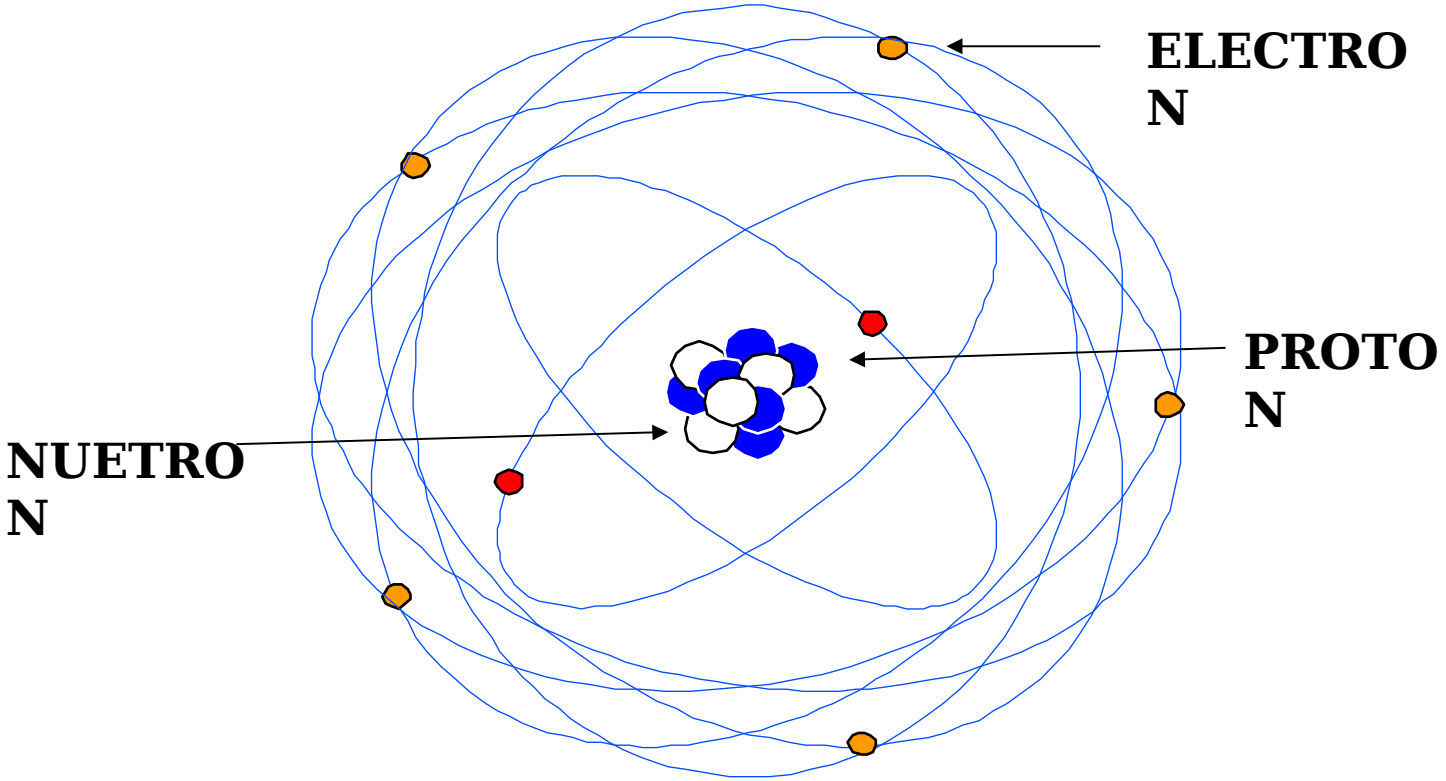


WELCOME TO BASIC ELECTRICITY



COPPER ATOM

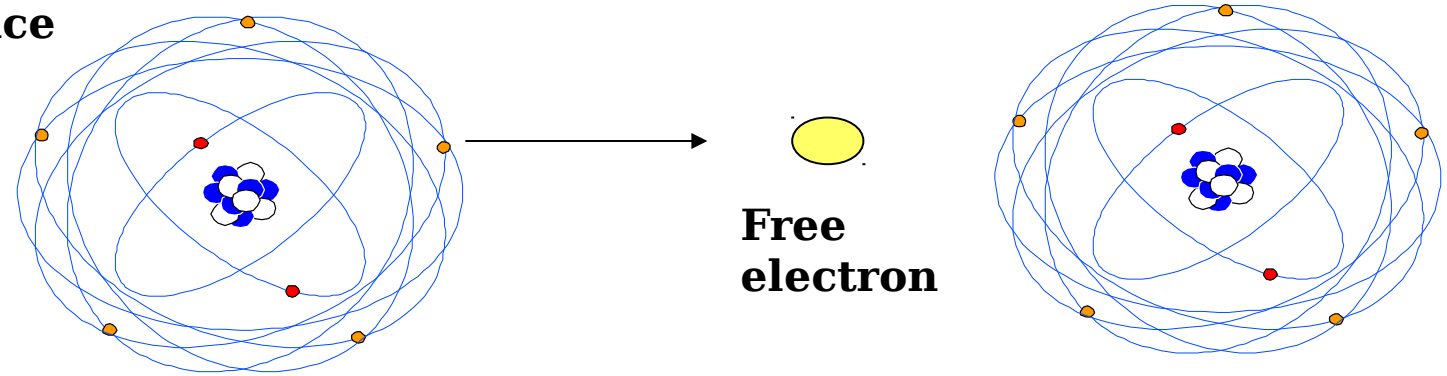
COMPOSITION OF MATTER



ATOMIC STRUCTURE

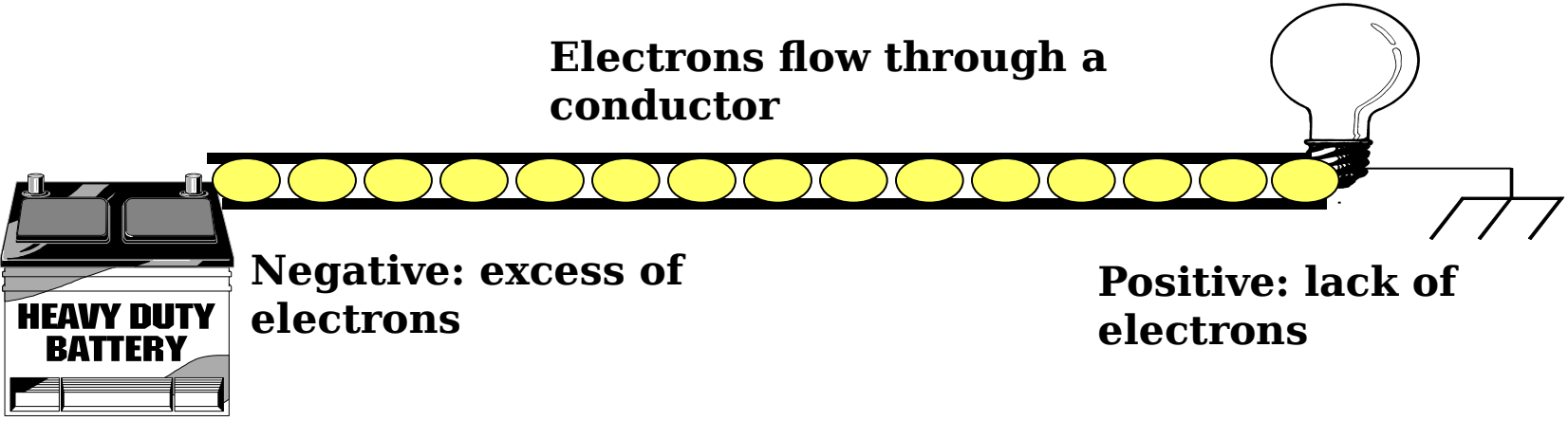
COMPOSITION OF ELECTRICITY

Valence ring



Free electron

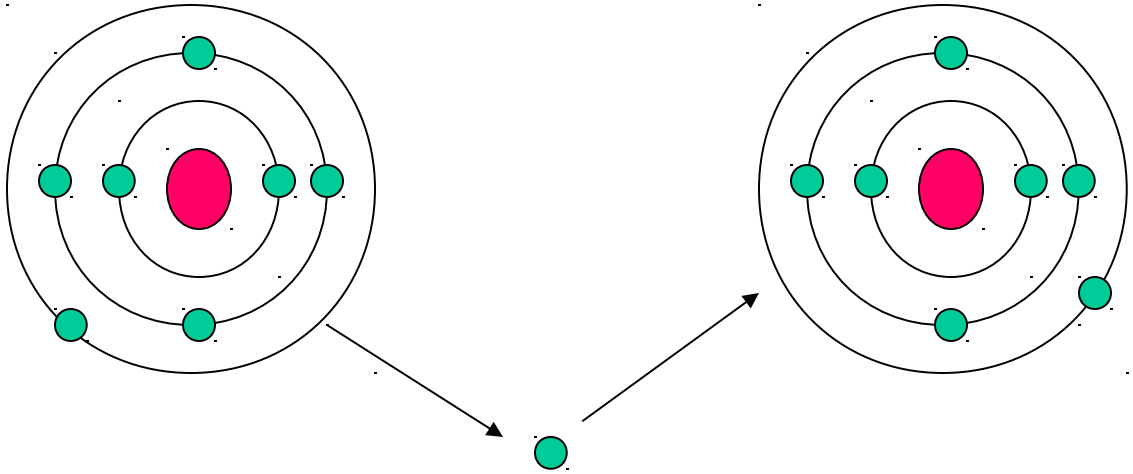
Electrons flow through a conductor



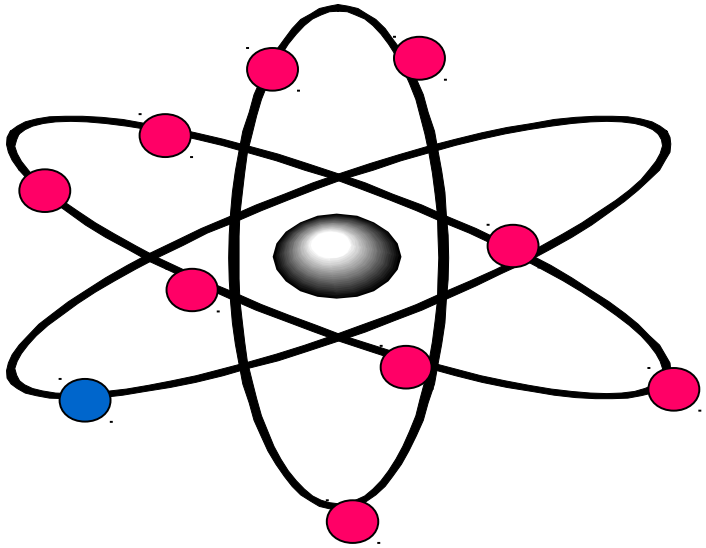
Negative: excess of electrons

Positive: lack of electrons

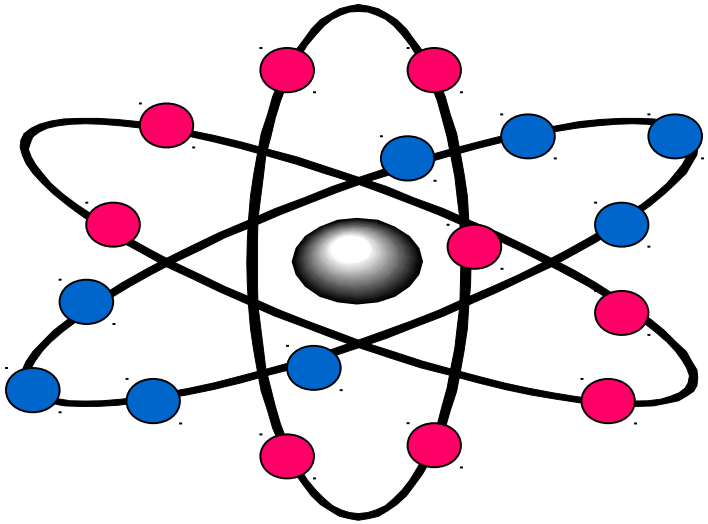
AN UNBALANCED POSITIVELY CHARGED ATOM WILL ATTRACT ELECTRONS FROM NEIGHBORING ATOMS



ION



CONDUCTORS: 1-3 ELECTRON IN VALENCE RING



INSULATOR: 5-8 ELECTRONS IN VALENCE RING

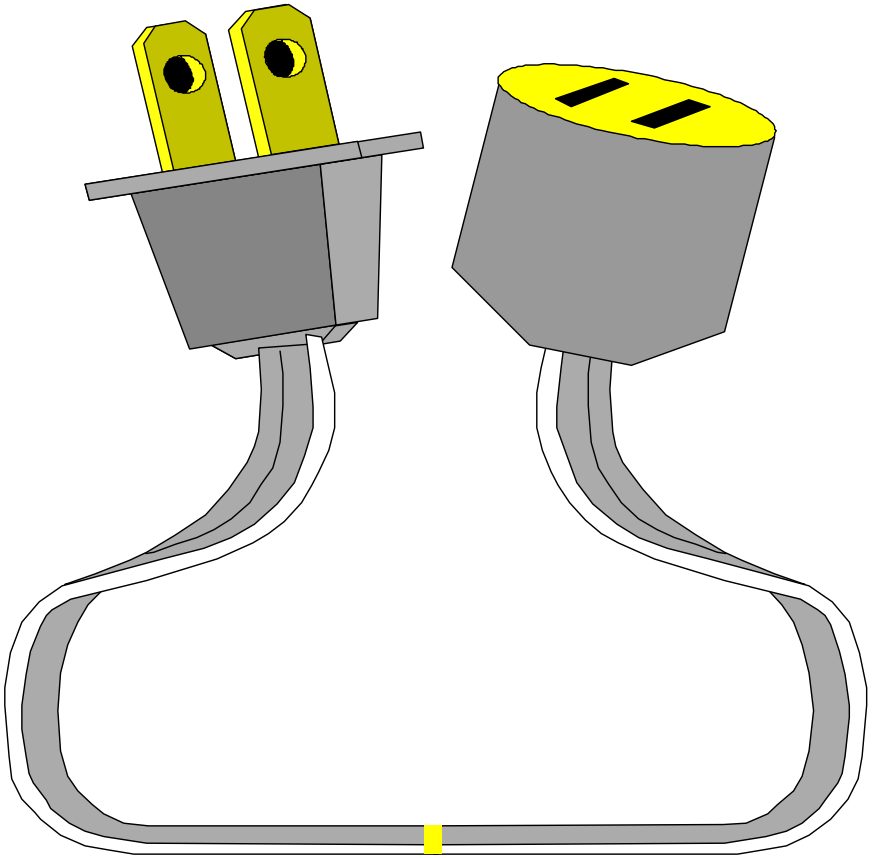
CONDUCTORS AND INSULATORS

CONDUCTORS

SILVER	0.936
COPPER	1.000
GOLD	1.403
CHROMINUM	1.530
ALUMINUM	1.549
TUNGSTEN	3.203

RELATIVE RESISTANCE OF COPPERCOMPARED TO OTHER METALS

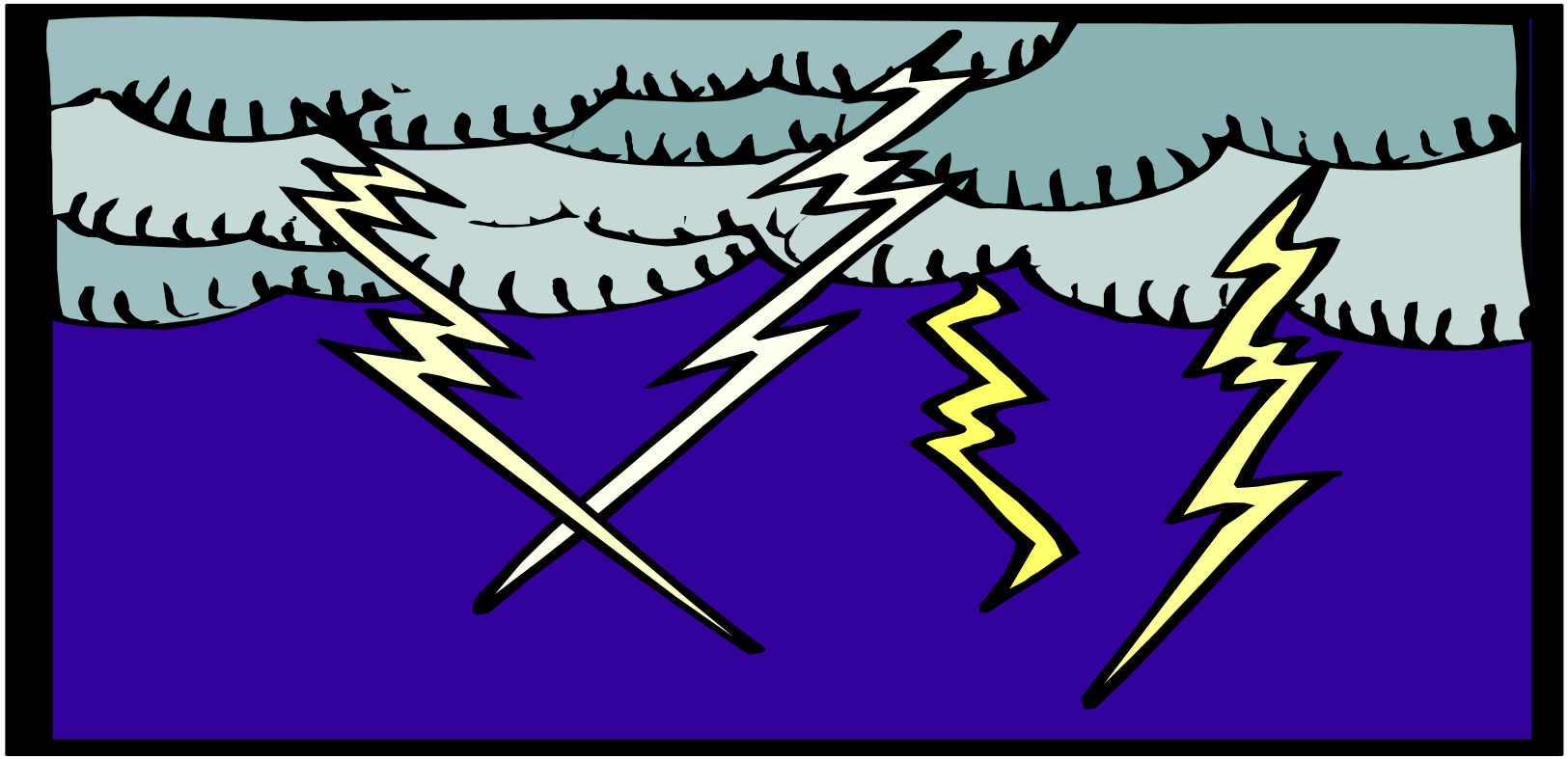
INSULATOR



REVIEW

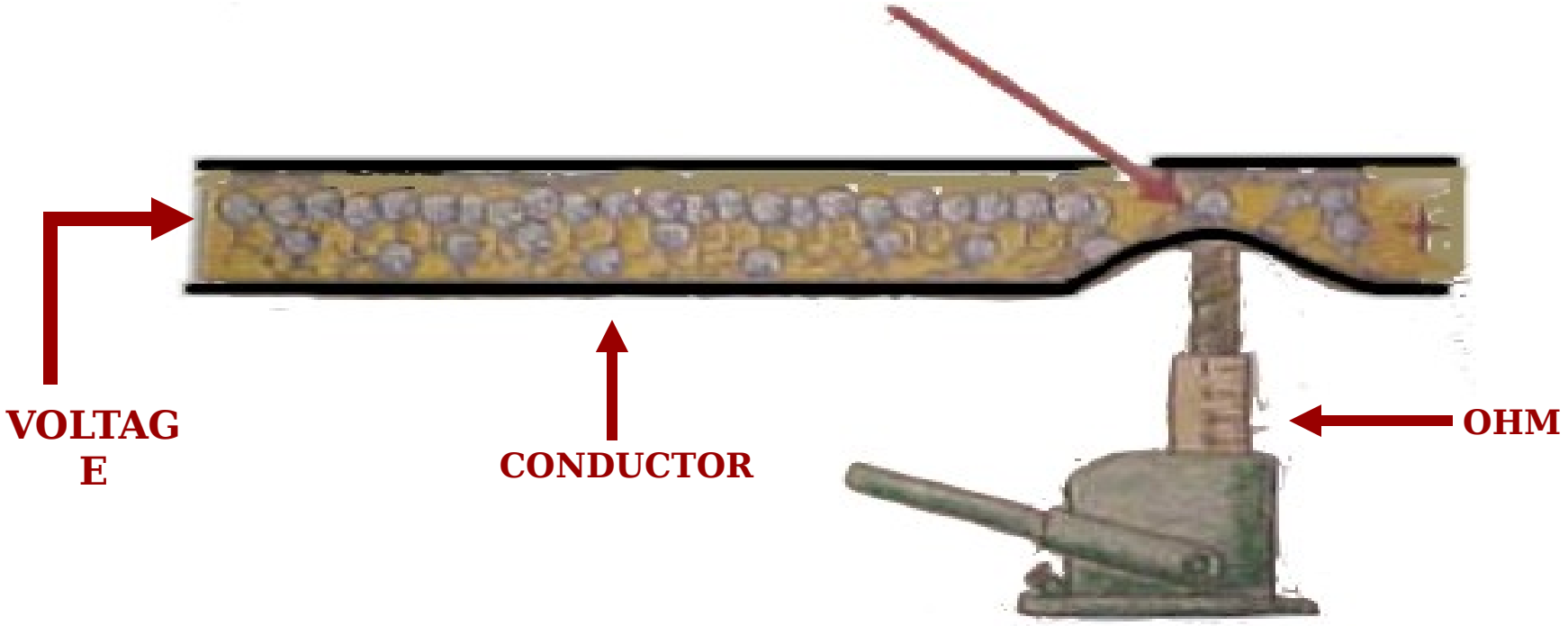
1. DEFINITIONS
2. ATOMIC STRUCTURE
3. COMPOSITION OF ELECTRICITY
4. CONDUCTORS AND INSULATORS

VOLTAGE



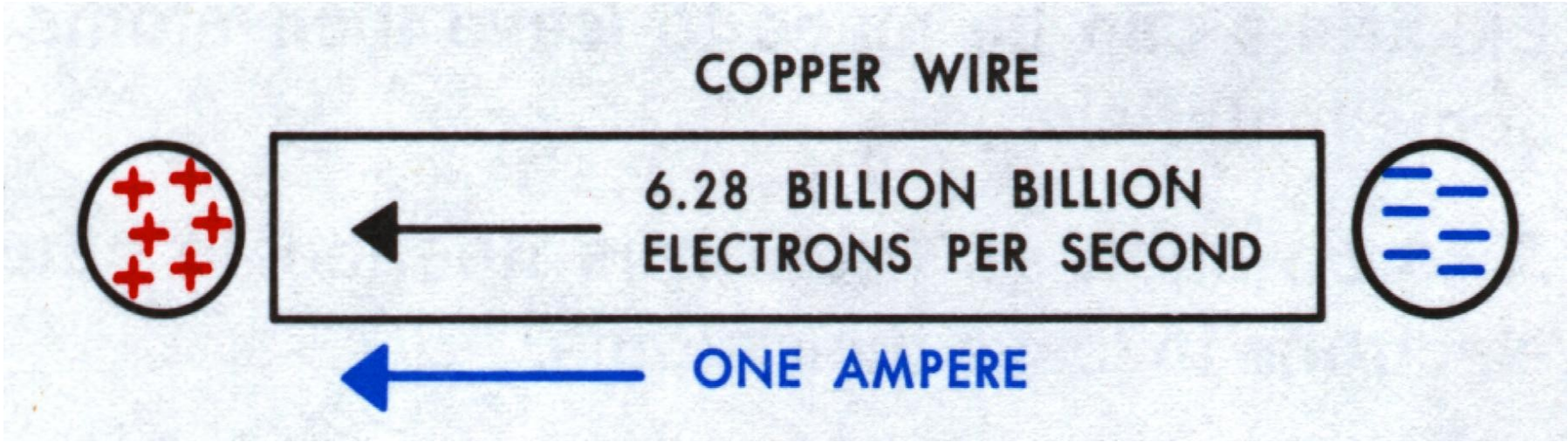
VOLTAGE IS PRESSURE

RESISTANCE



RESISTANCE IS MEASURED IN OHM's

CURRENT

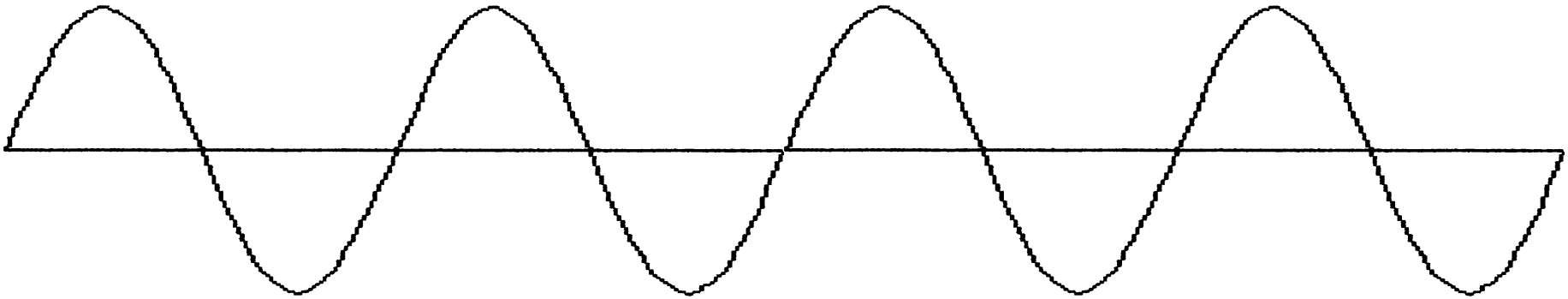


HOW CURRENT IS MEASURED

ALTERNATING CURRENT

REVERSES DIRECTIONS AT REGULAR INTERVALS

POSITIVE



NEGATIV
E

DIRECT CURRENT

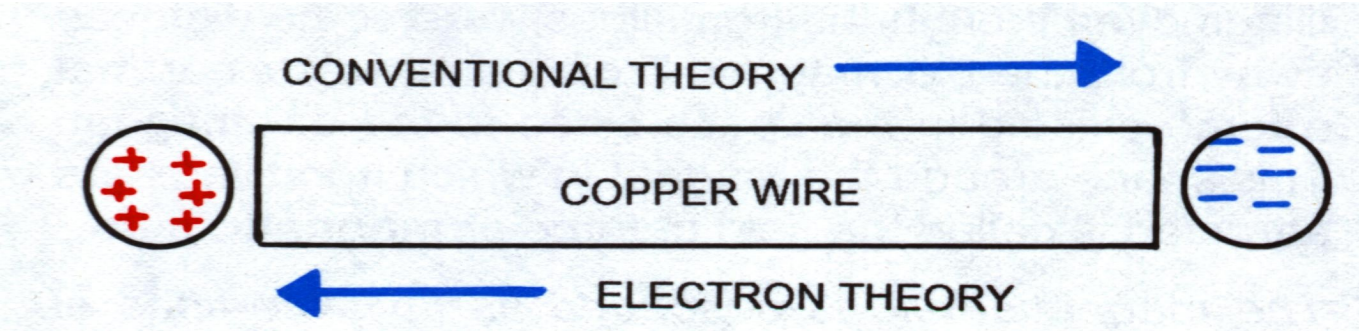
POSITIVE IS ALWAYS POSITIVE

+ +

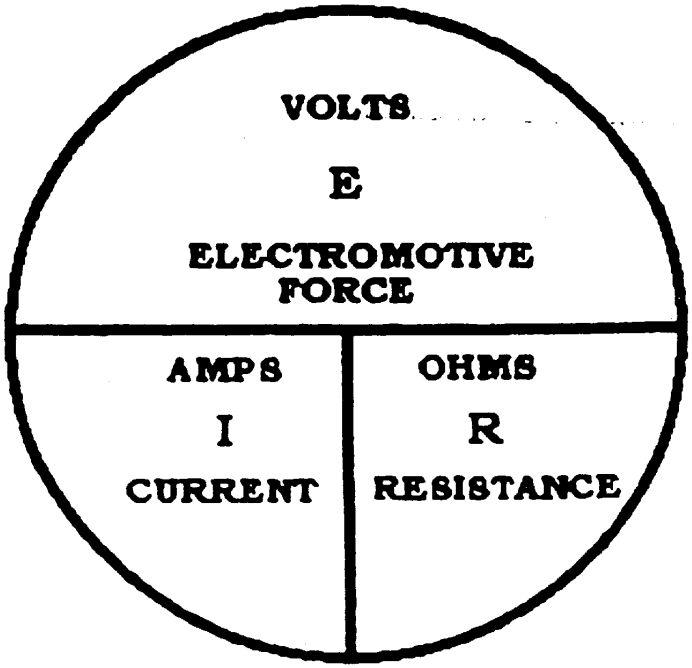
NEGATIVE IS ALWAYS NEGATIVE

- -

ELECTRON THEORY OF ELECTRICITY



OHMS LAW

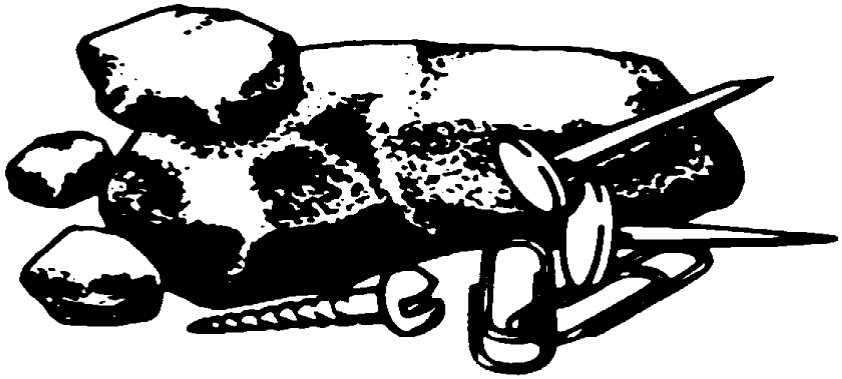


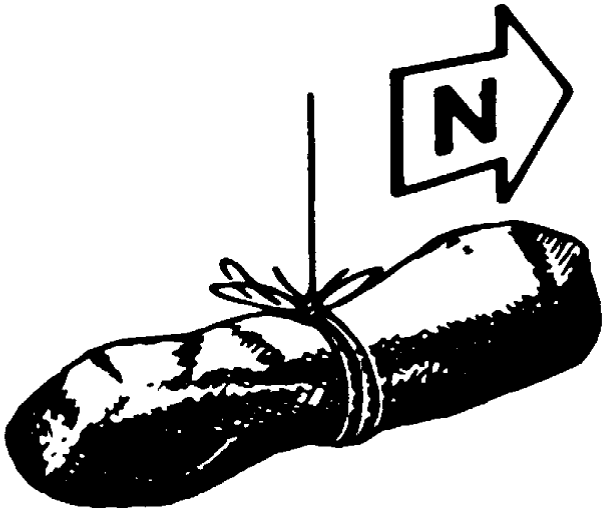
VOLTS = AMPS X OHMS

AMPS = VOLTS / OHMS

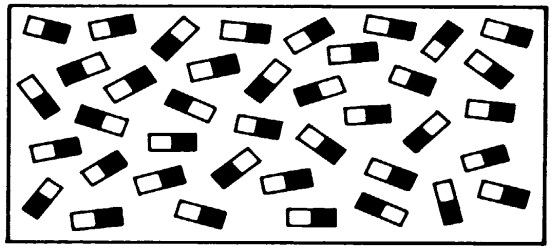
OHMS = VOLTS / AMPS

MAGNETISM

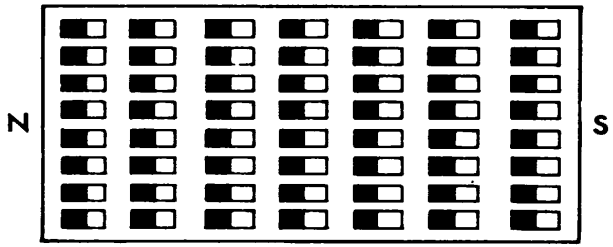




FIRST THEORY OF MAGNETISM



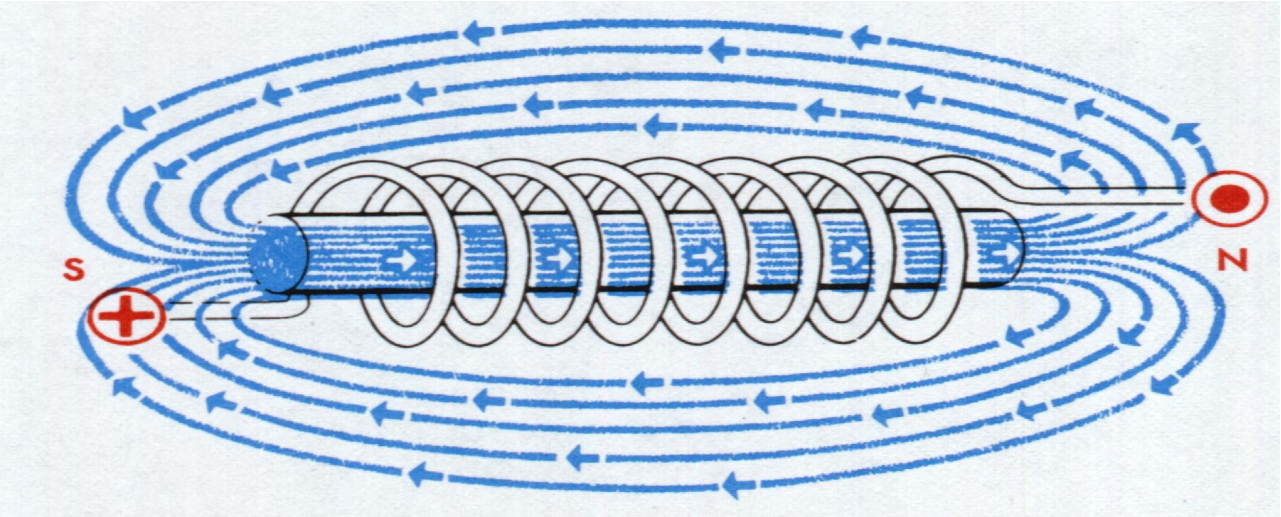
UNMAGNETIZED IRON



MAGNETIZED IRON

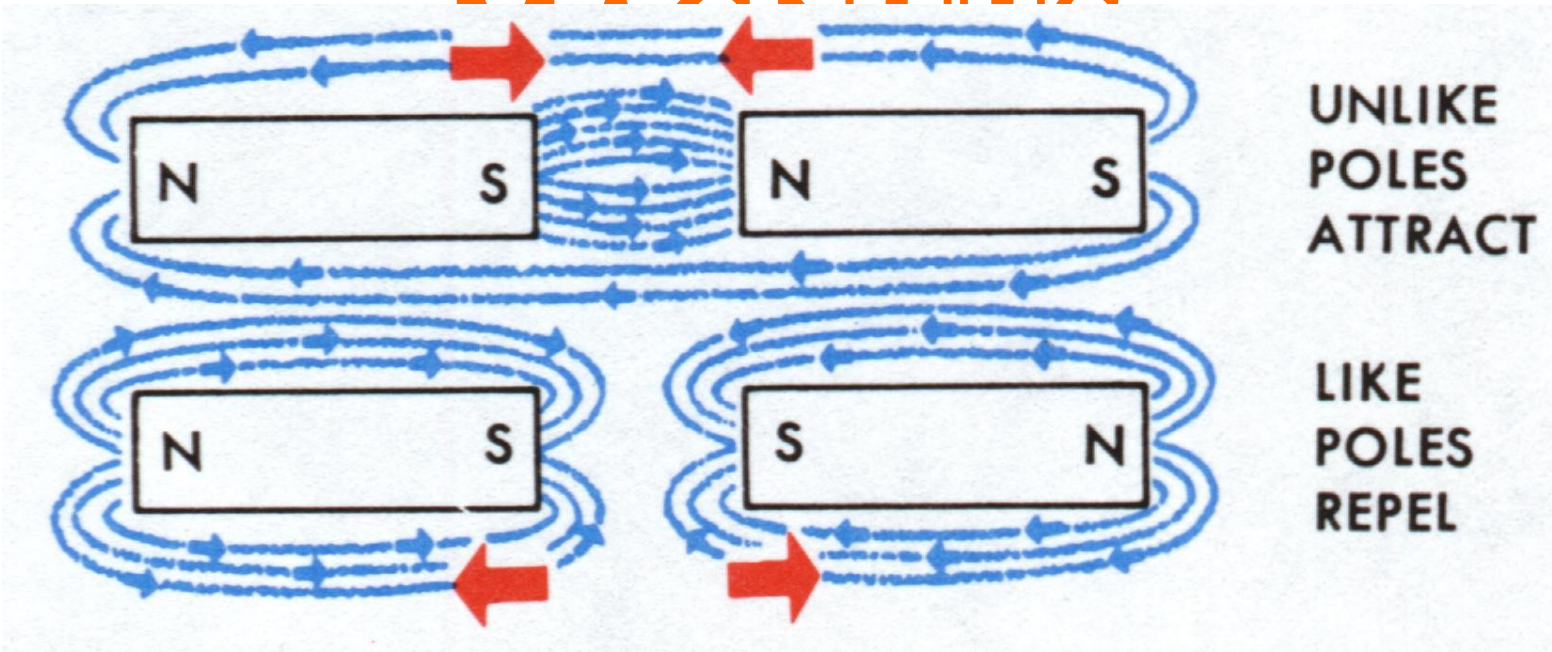
ELECTROMAGNET

WRAPPING A CONDUCTOR AROUND AN IRON CORE AND APPLYING ELECTRICITY WILL PRODUCE AN

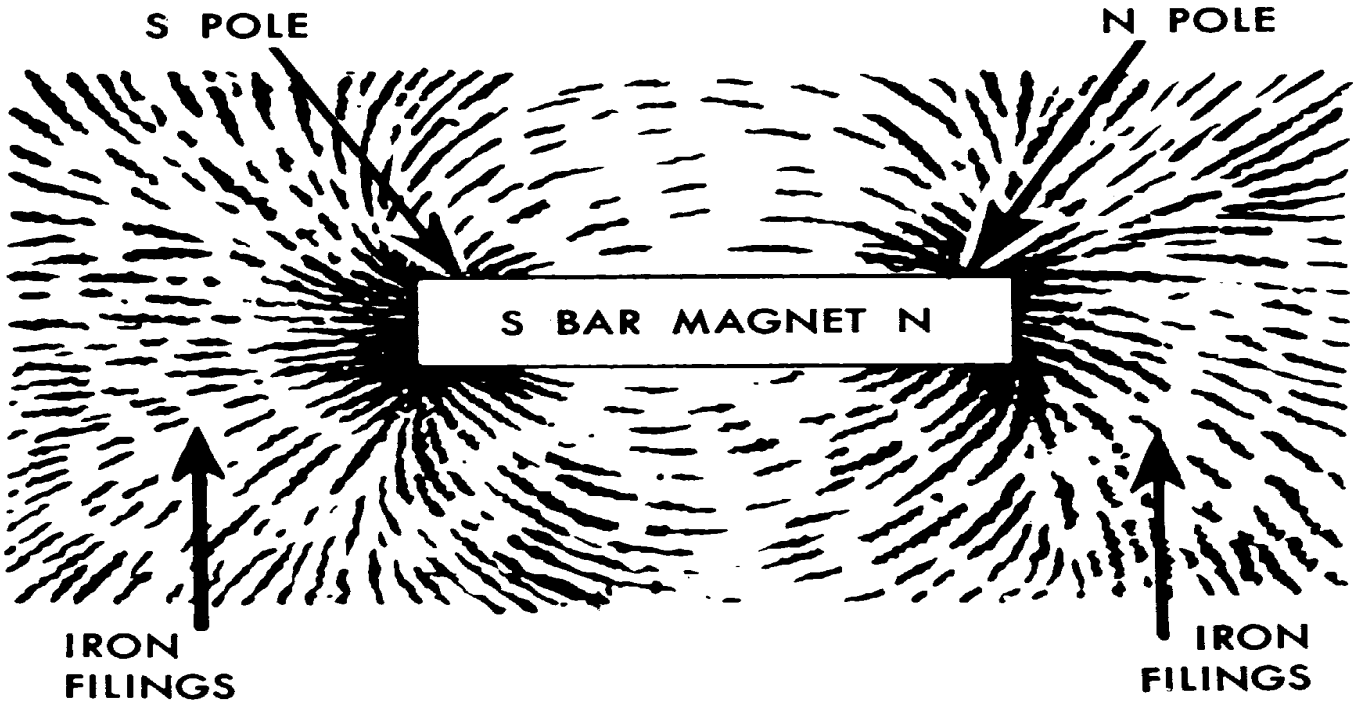


THE MAGNETIC FIELD MAY BE INCREASED BY ADDING MORE WRAPS OF WIRE OR APPLYING MORE ELECTRICITY

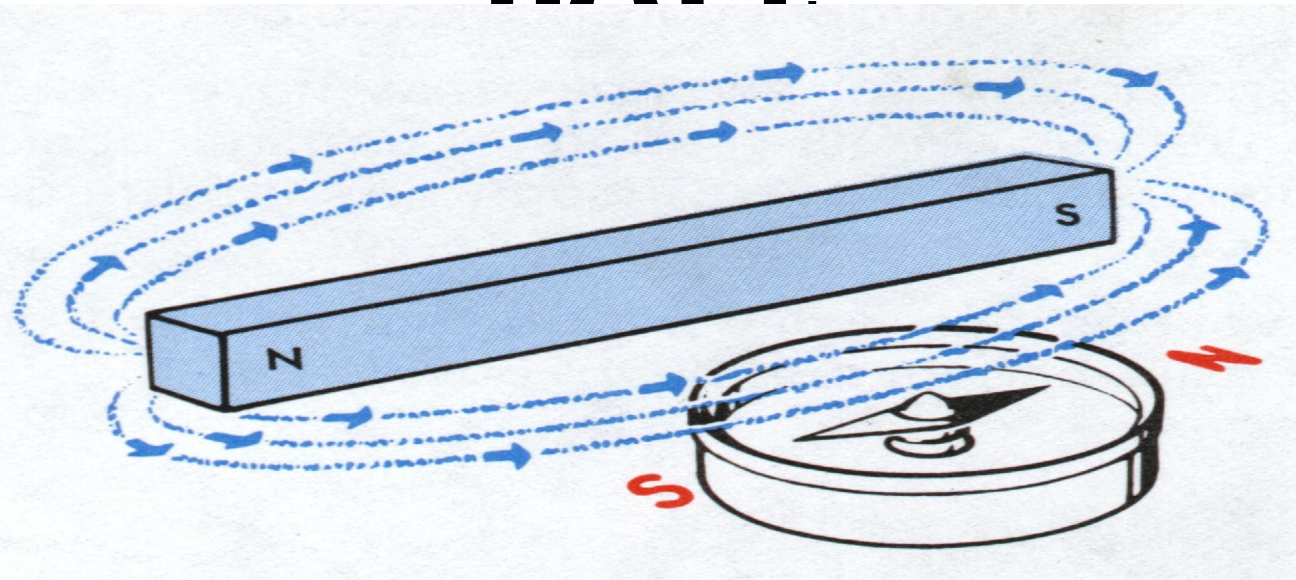
MAGNETIC FORCES BETWEEN POLES OF BAR MAGNETS



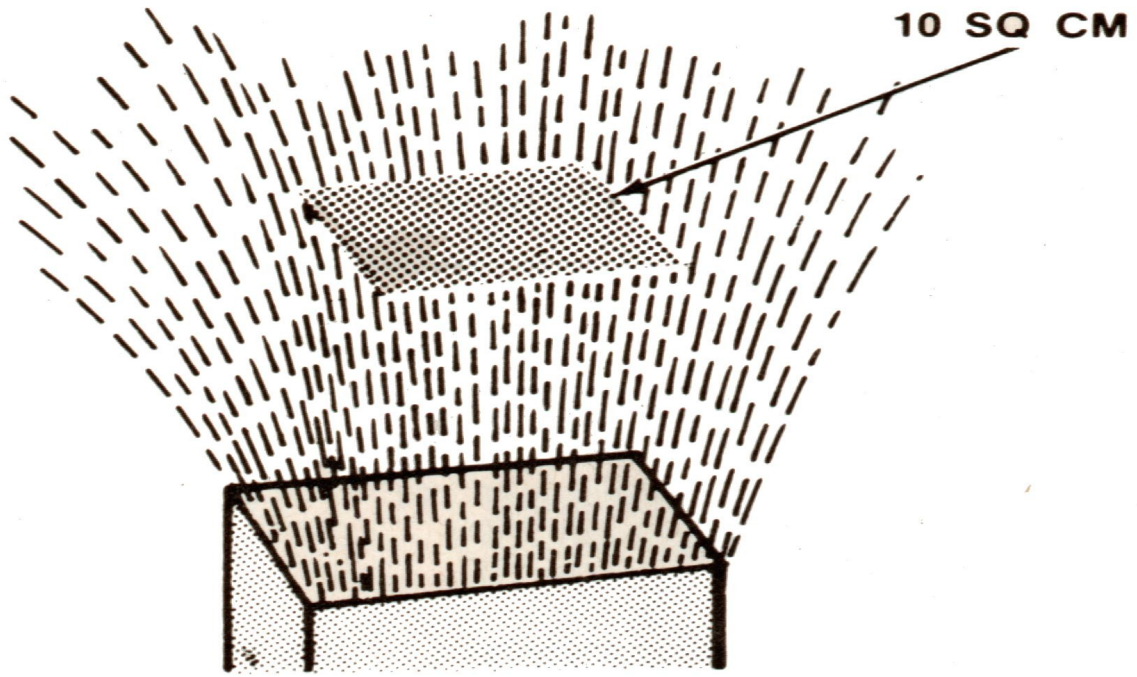
MAGNETIC FIELD OF A BAR MAGNET



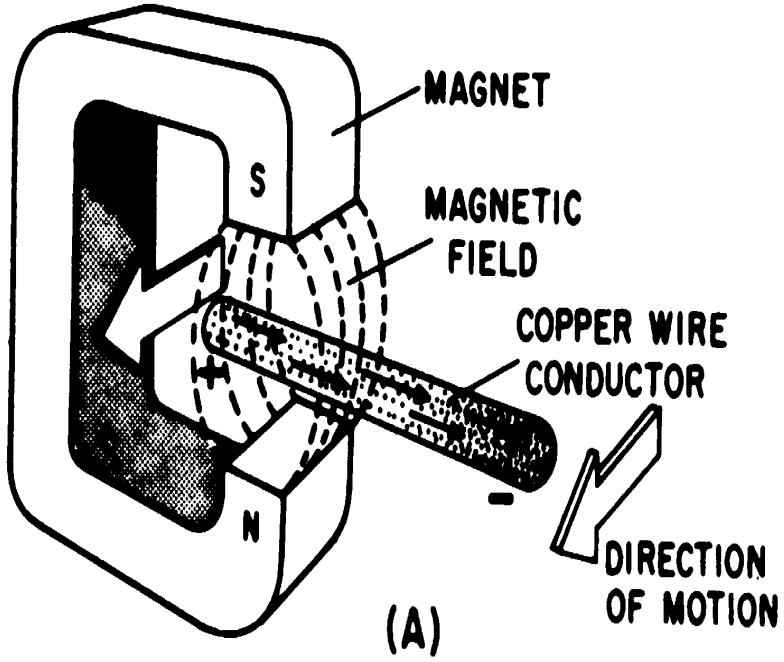
MAGNETIC LINES OF FORCE COME OUT OF N POLE AND ENTER S POLE

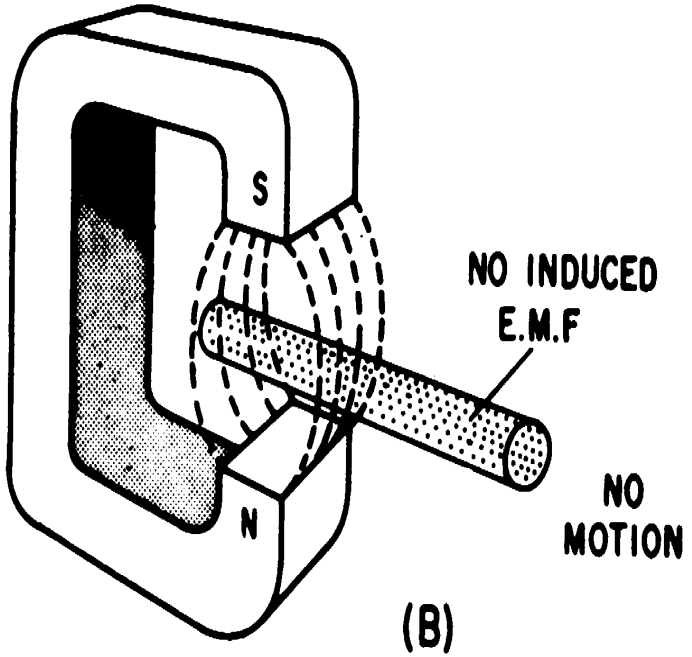


FLUX DENSITY EQUALS THE NUMBER OF LINES OF FORCE PER UNIT OF AREA



VOLTAGE PRODUCED BY MAGNETISM

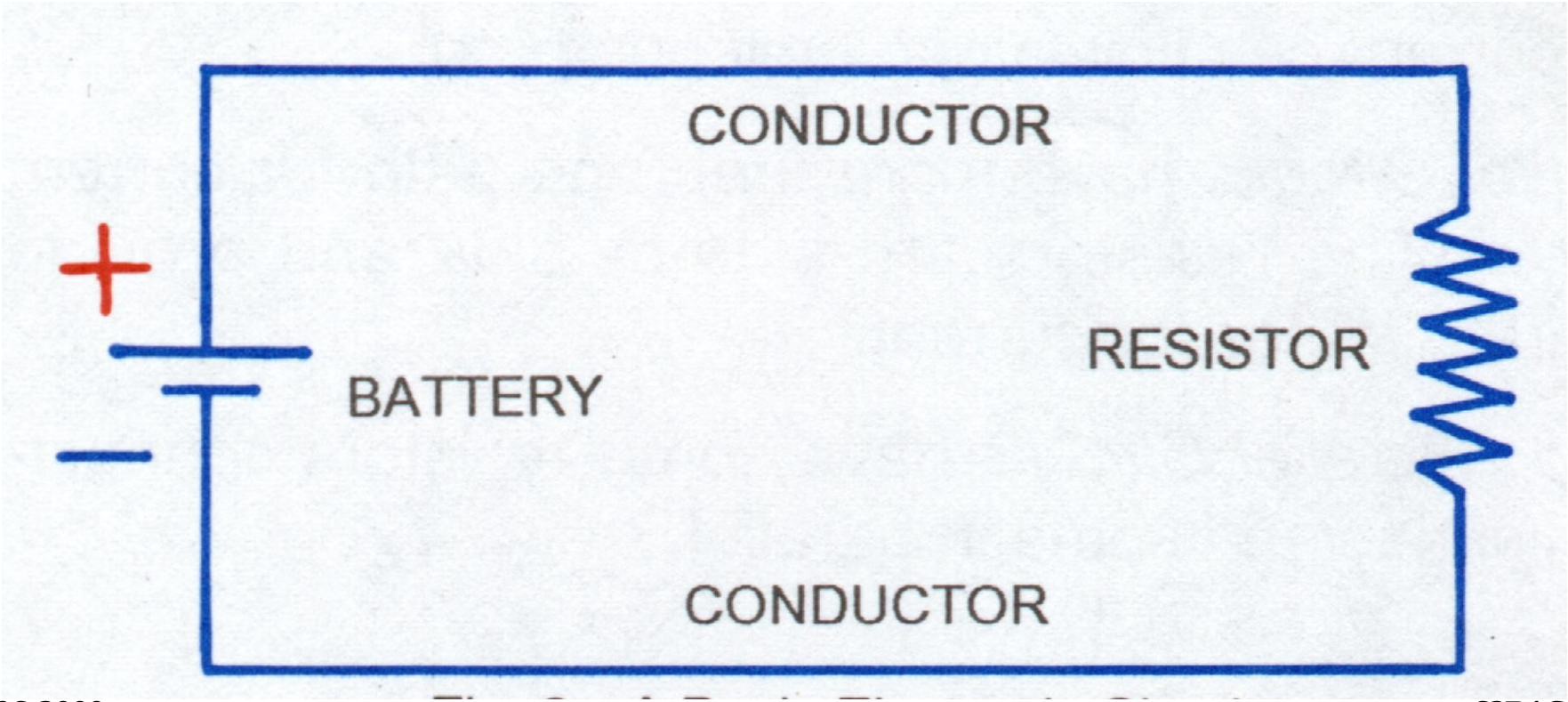




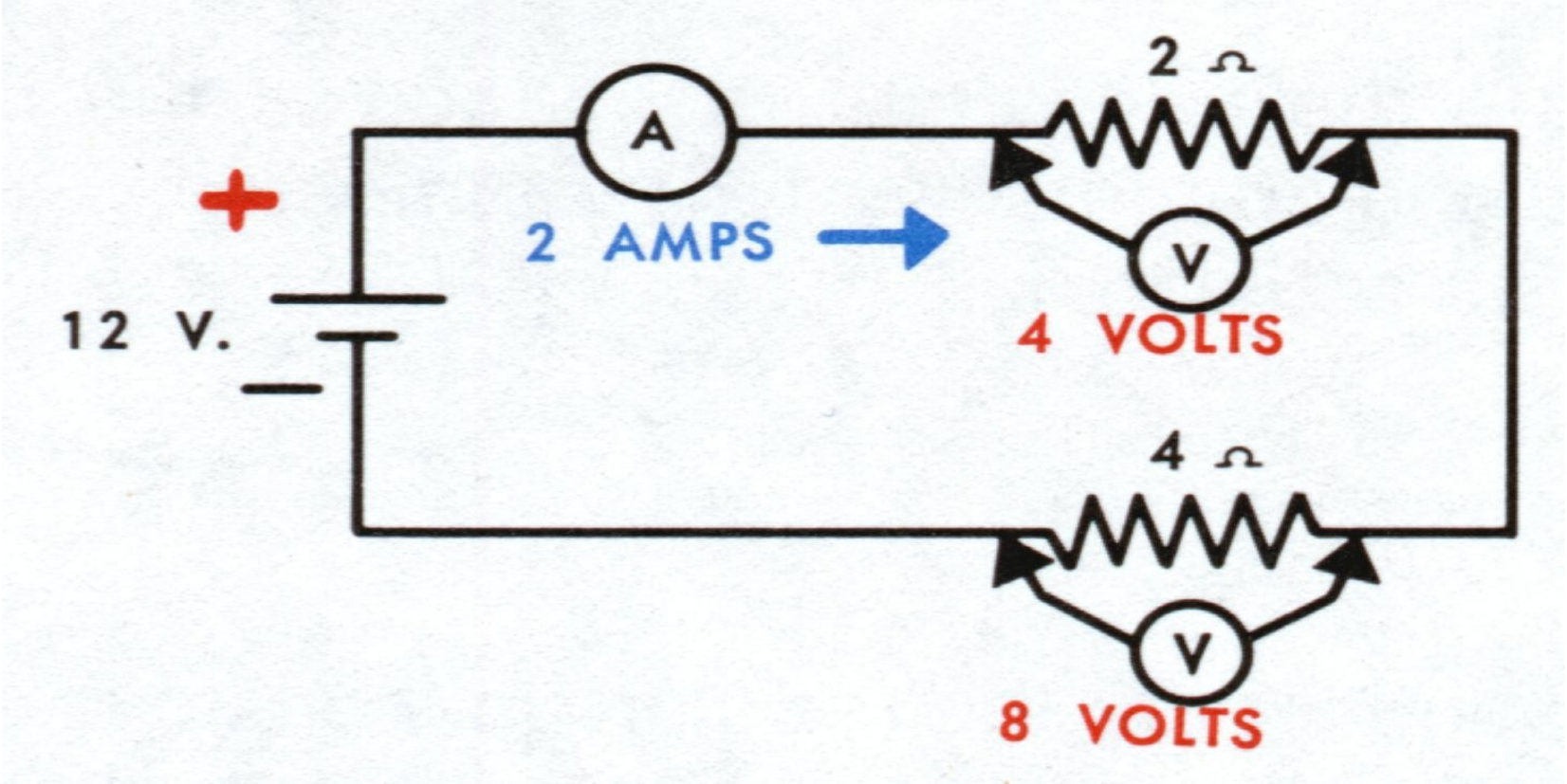
REVIEW

1. VOLTAGE, RESISTANCE AND CURRENT
2. TYPES OF CURRENT
3. ELECTRON THEORY
4. OHM’s LAW
5. MAGNETISM

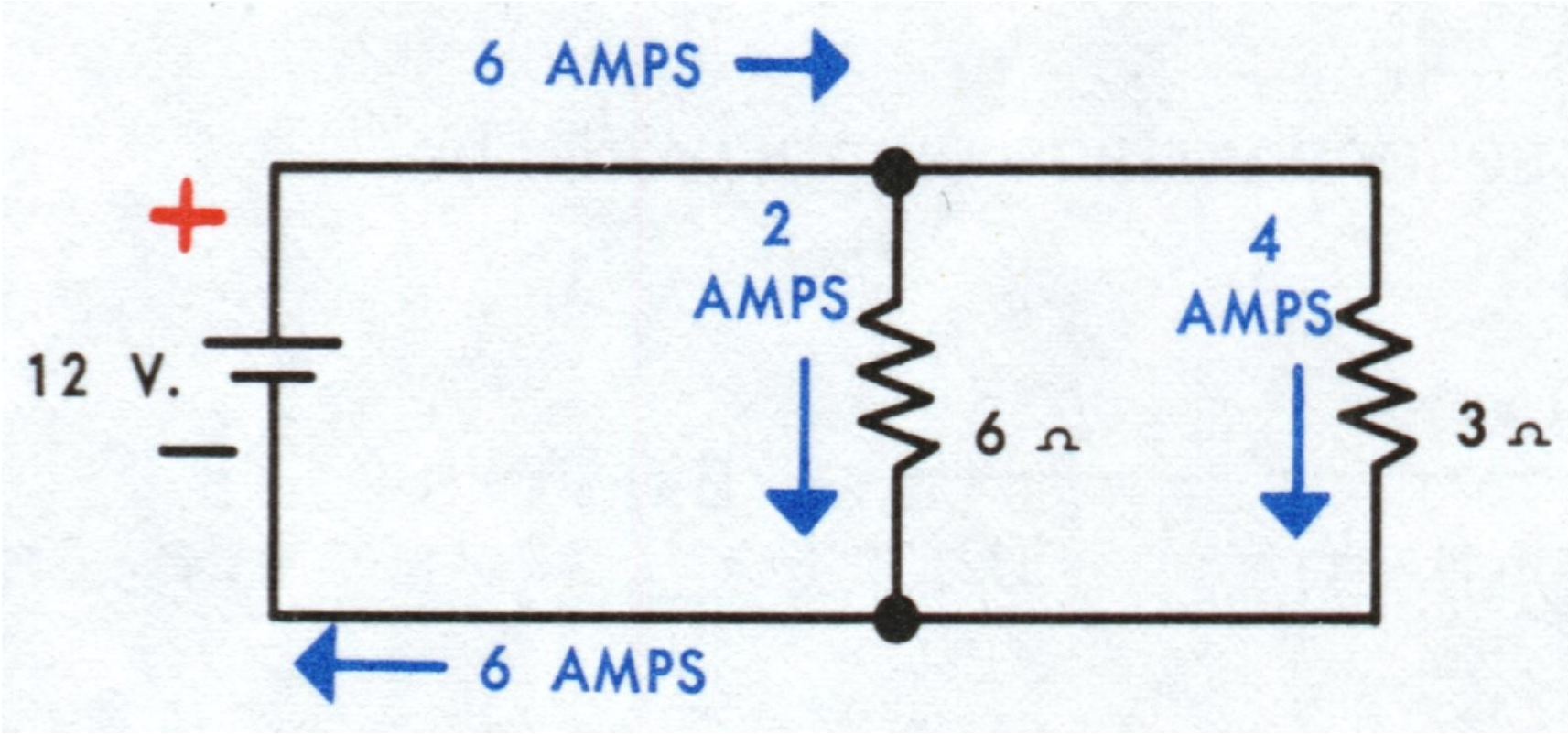
BASIC ELECTRICAL CIRCUIT



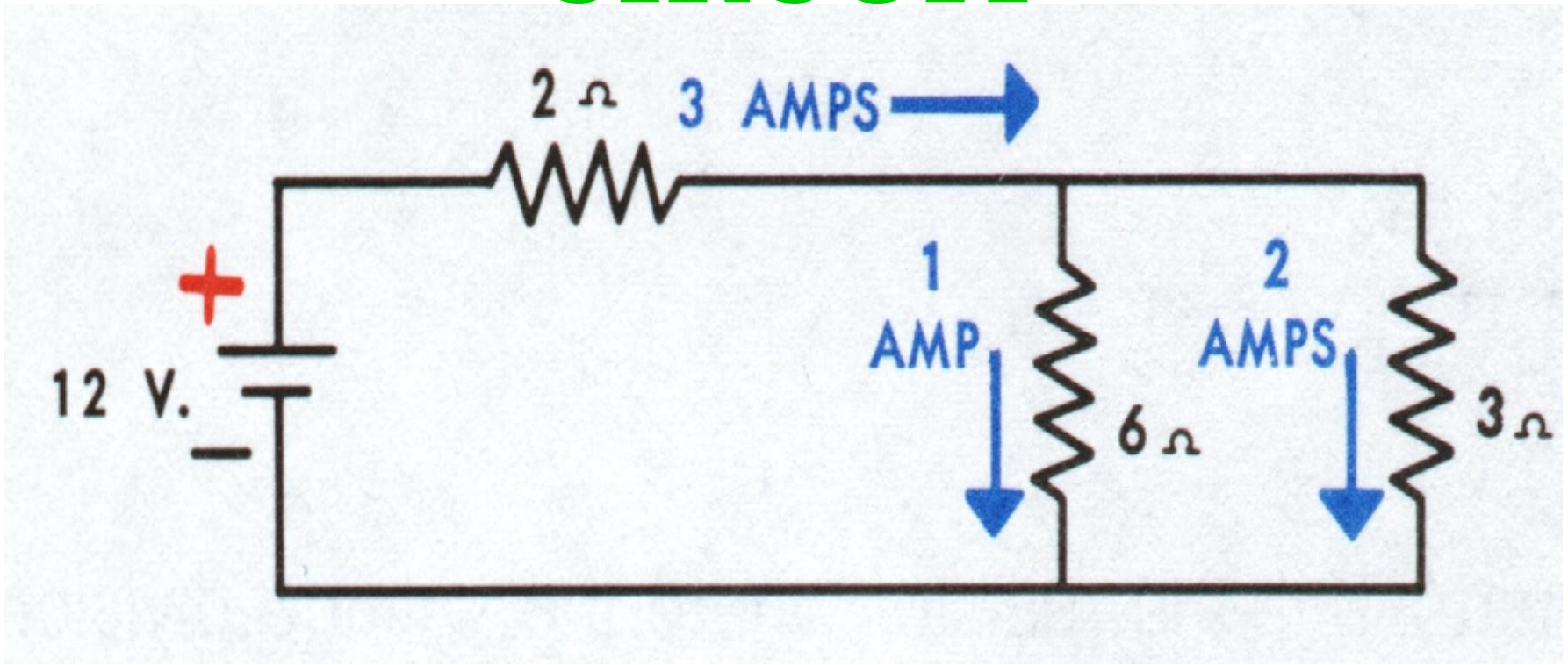
SERIES CIRCUIT



PARALLEL CIRCUIT

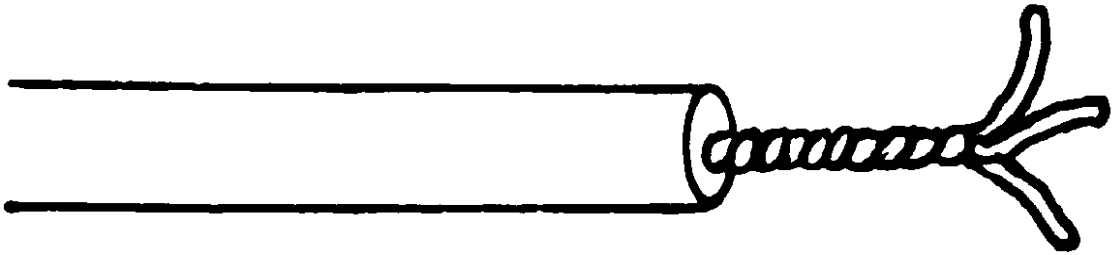


SERIES-PARALLEL CIRCUIT



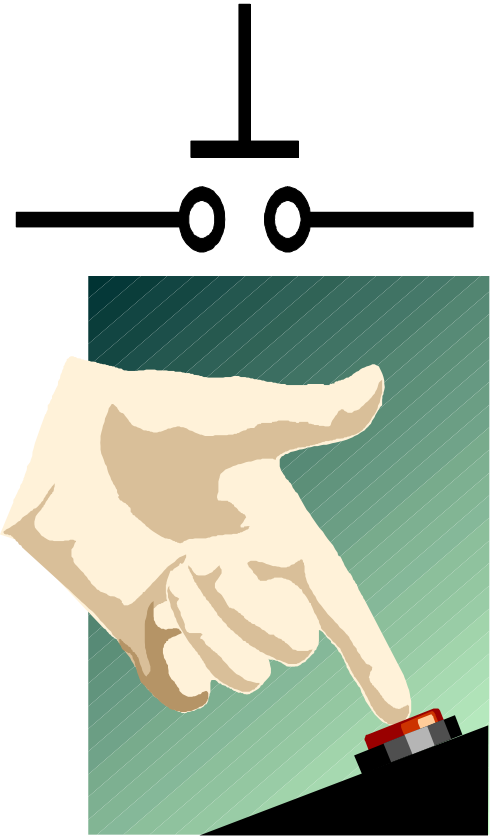
TYPES OF WIRING

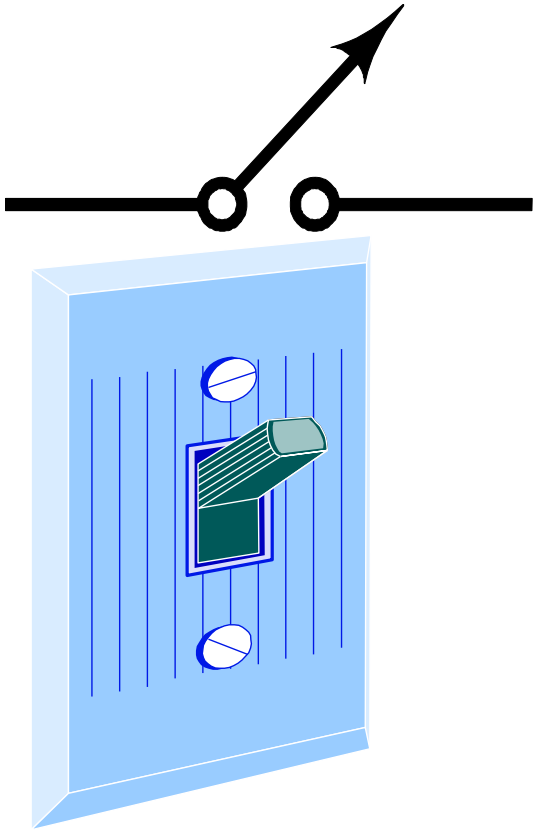
SOLID WIRE



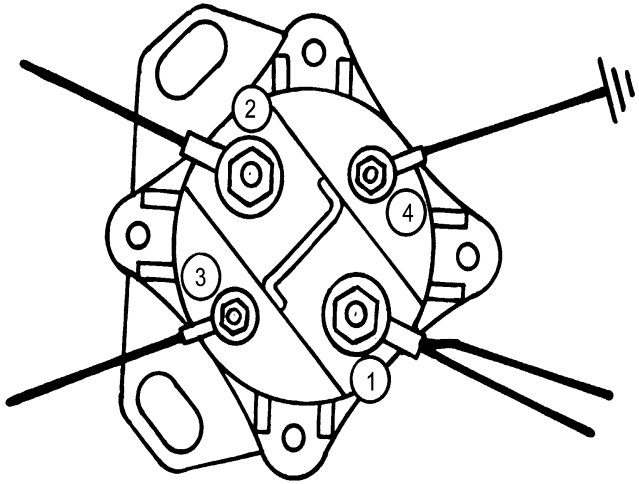
STRANDED WIRE

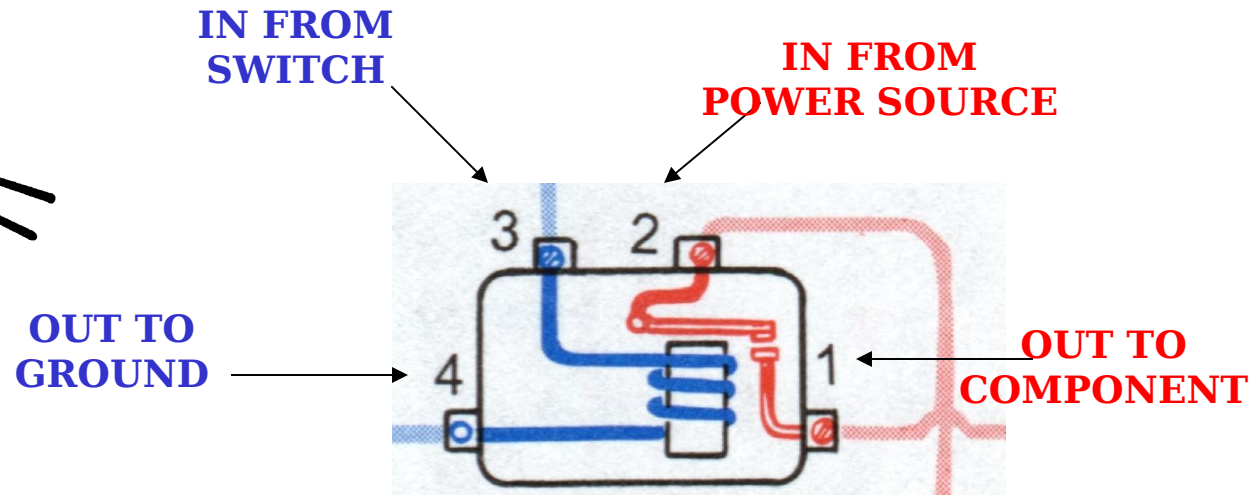
SWITCHES



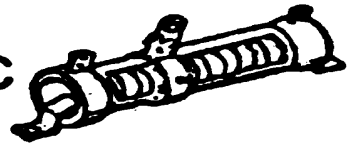
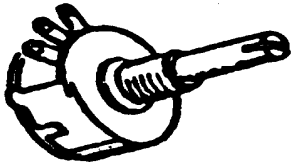
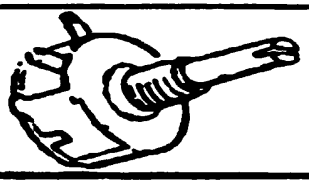
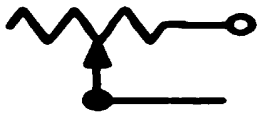


MAGNETIC SWITCHES

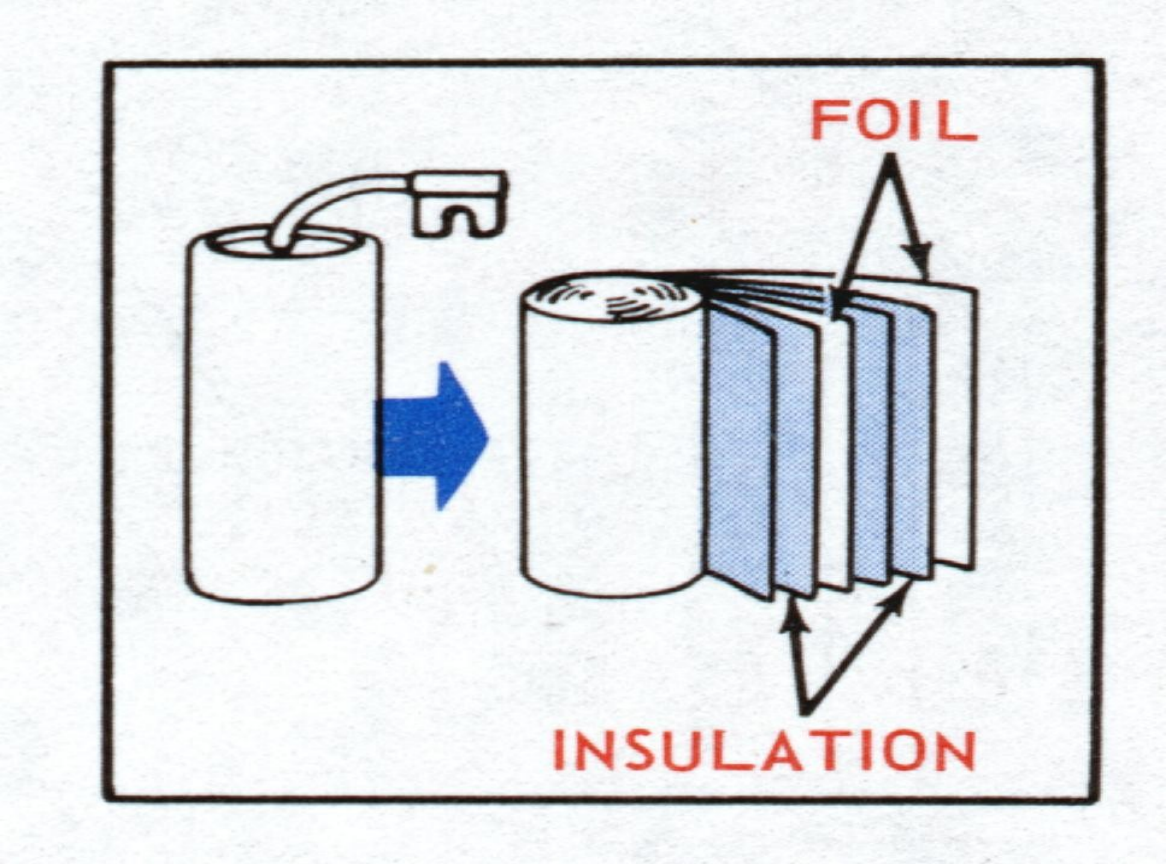




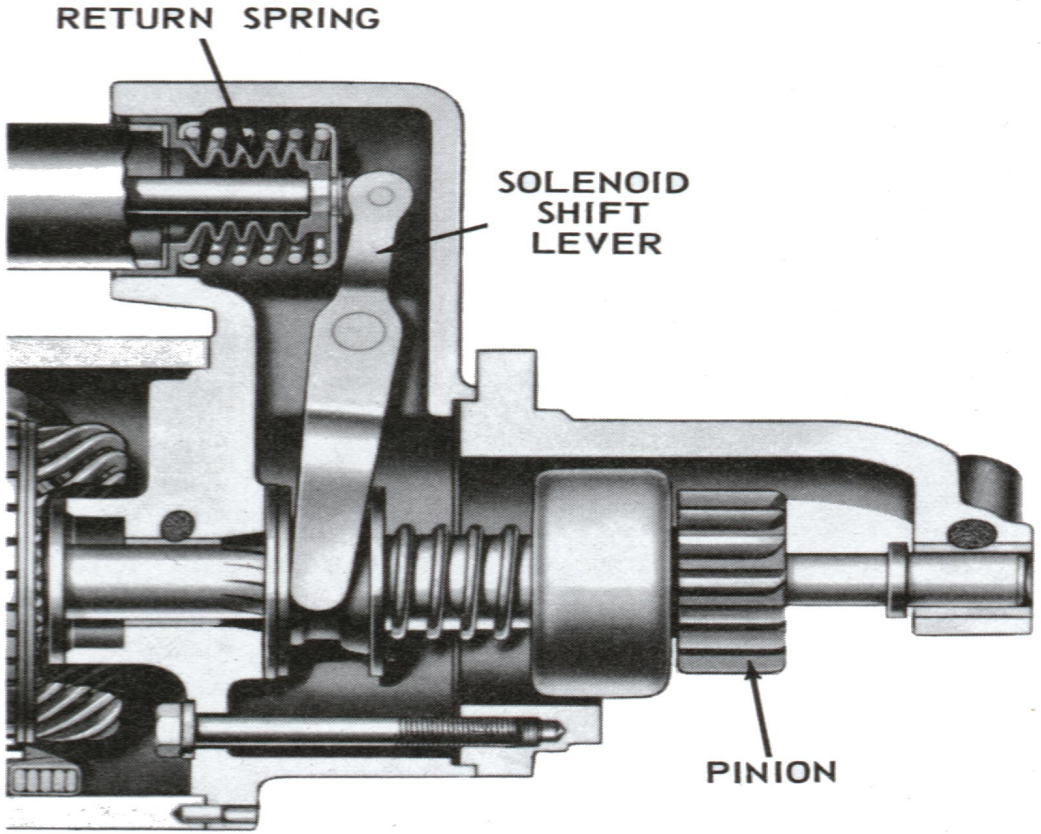
RESISTORS

TYPICAL RESISTOR	TYPE	SYMBOL
A 	FIXED CARBON	
B 	FIXED WIREWOUND (TAPPED)	
C 	ADJUSTABLE WIREWOUND	
D 	POTENTIOMETER	
E 	RHEOSTAT	

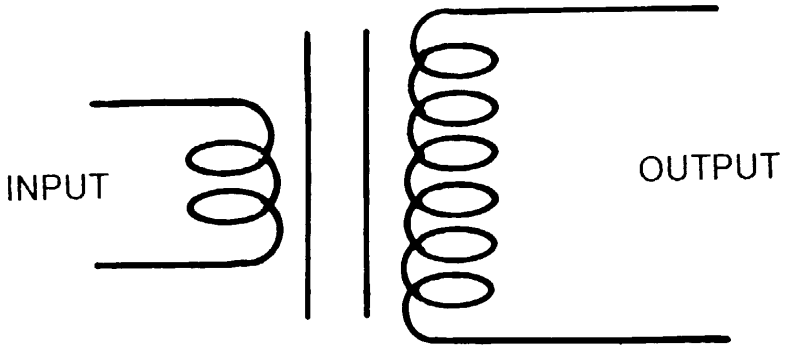
CAPACITORS



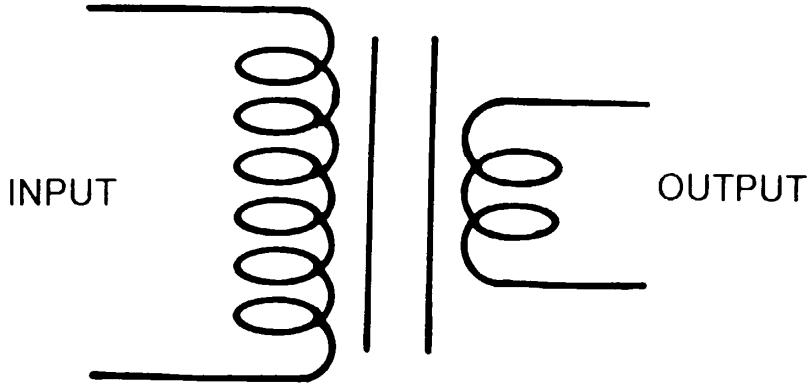
SOLENOID SWITCHES



TRANSFORMERS

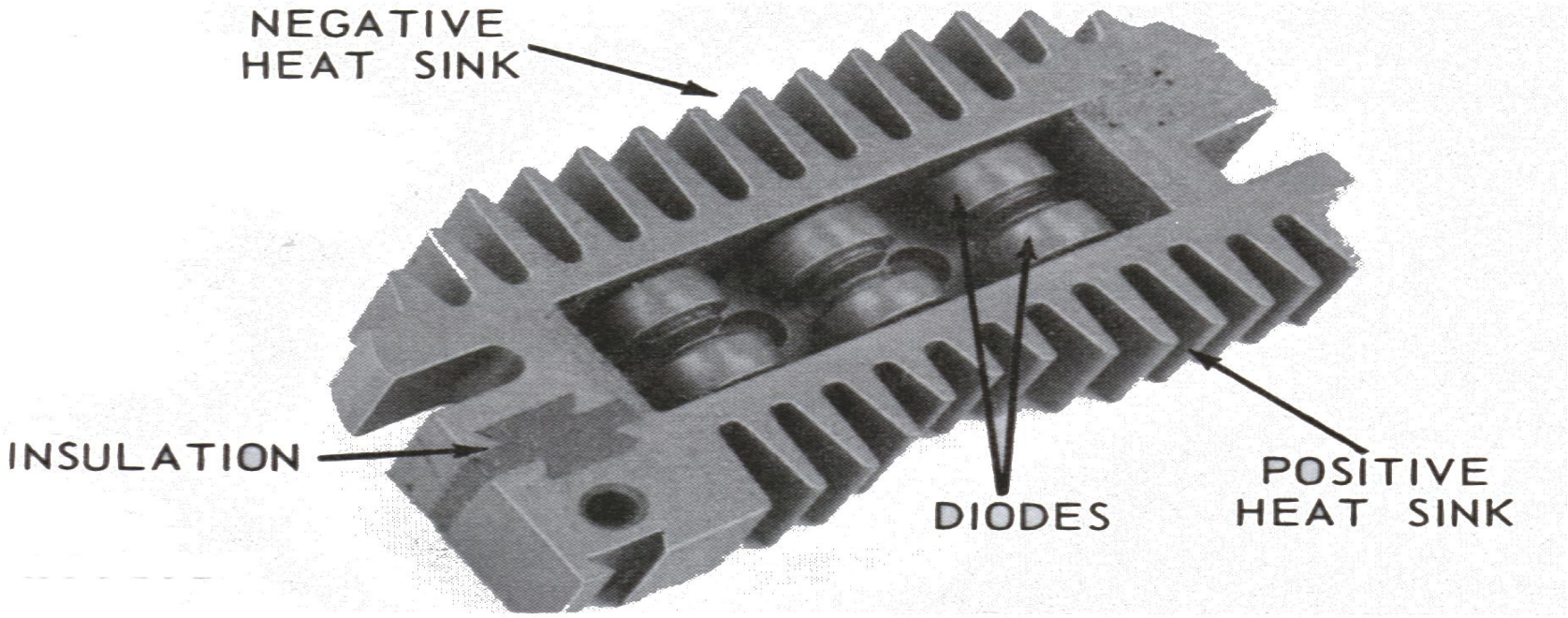


STEP UP



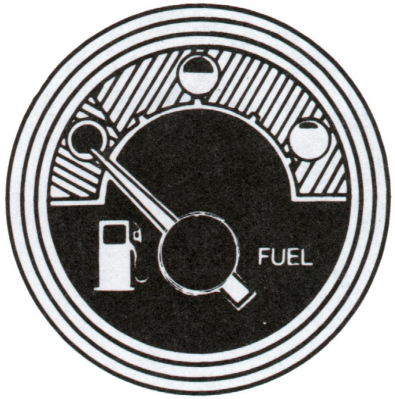
STEP DOWN

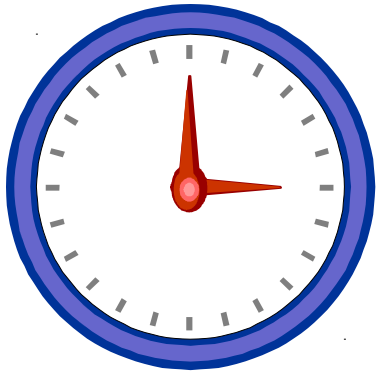
DIODES



RECTIFIER BRIDGE

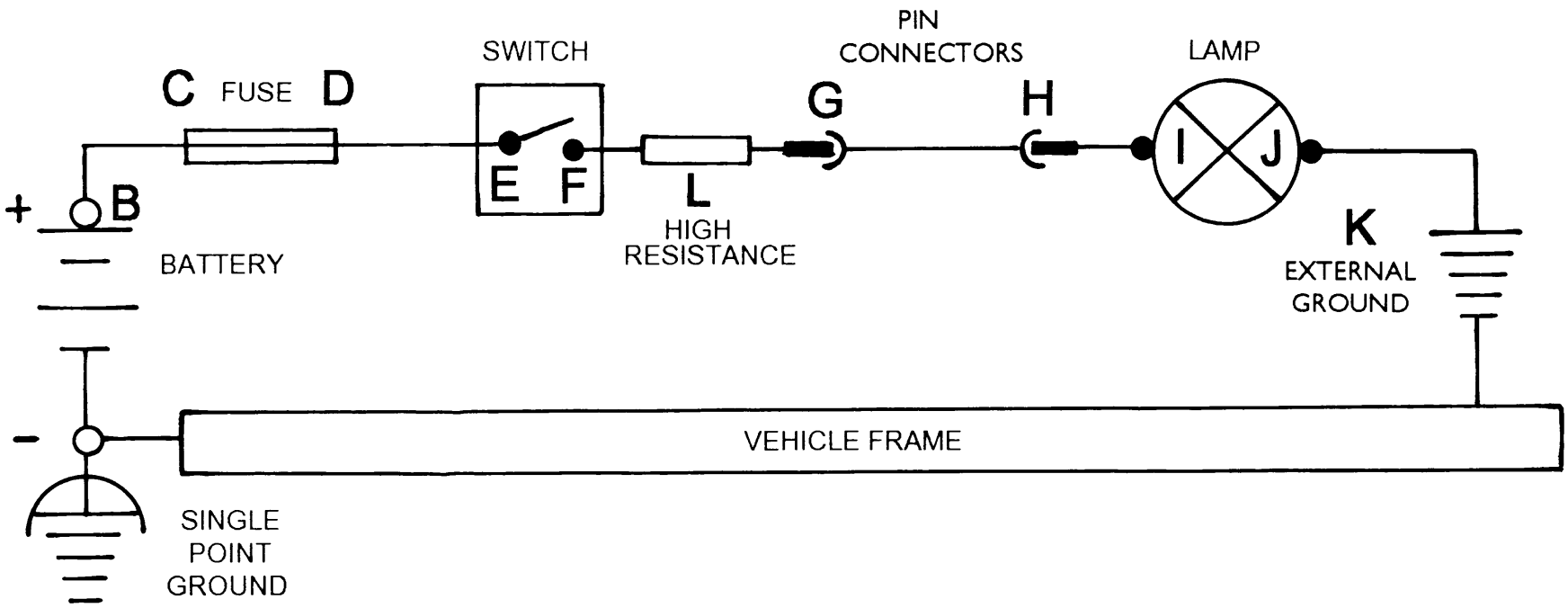
CONTROL DEVICES





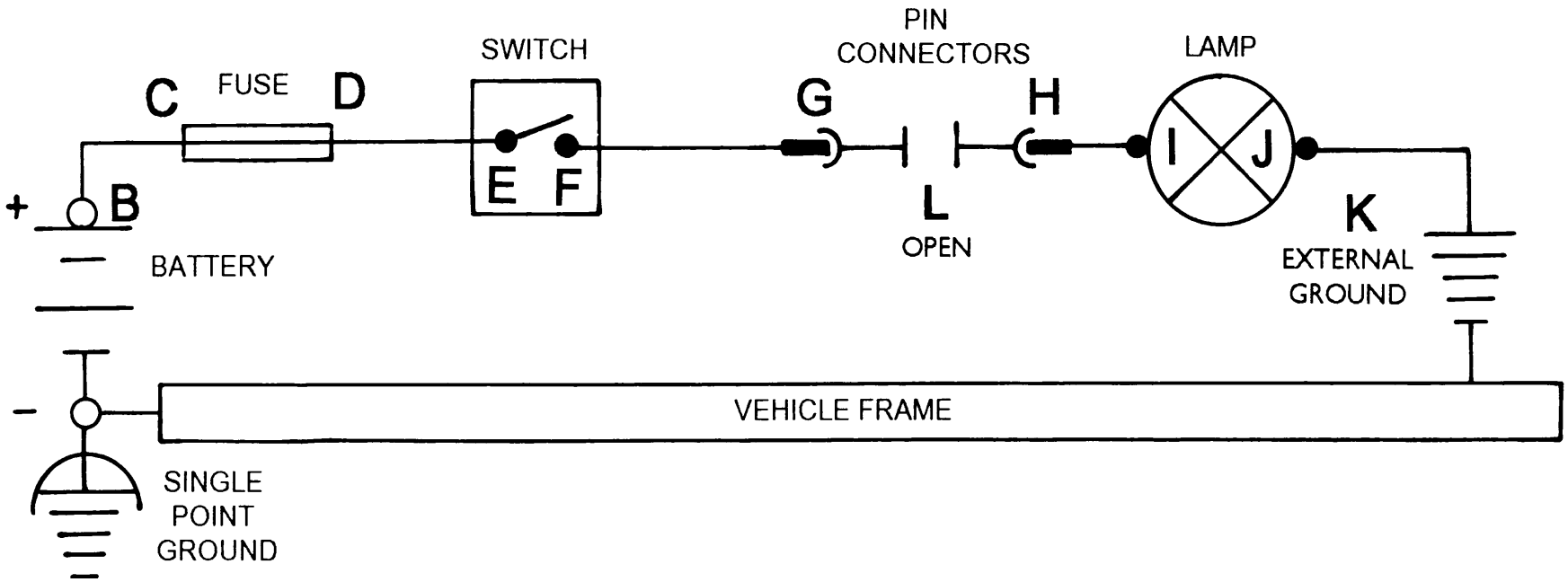
GAUGES AND INDICATORS

BASIC ELECTRICAL CIRCUIT FAULTS



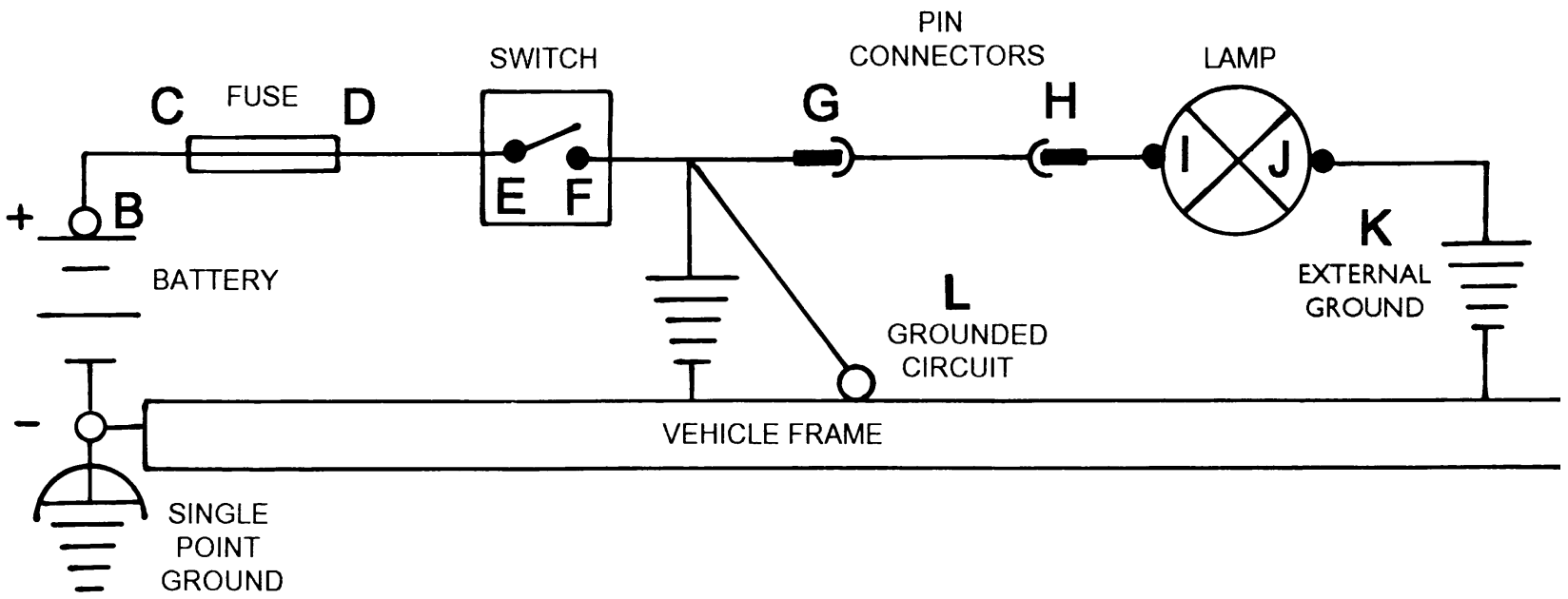
HIGH RESISTANCE

BASIC ELECTRICAL CIRCUIT FAULTS



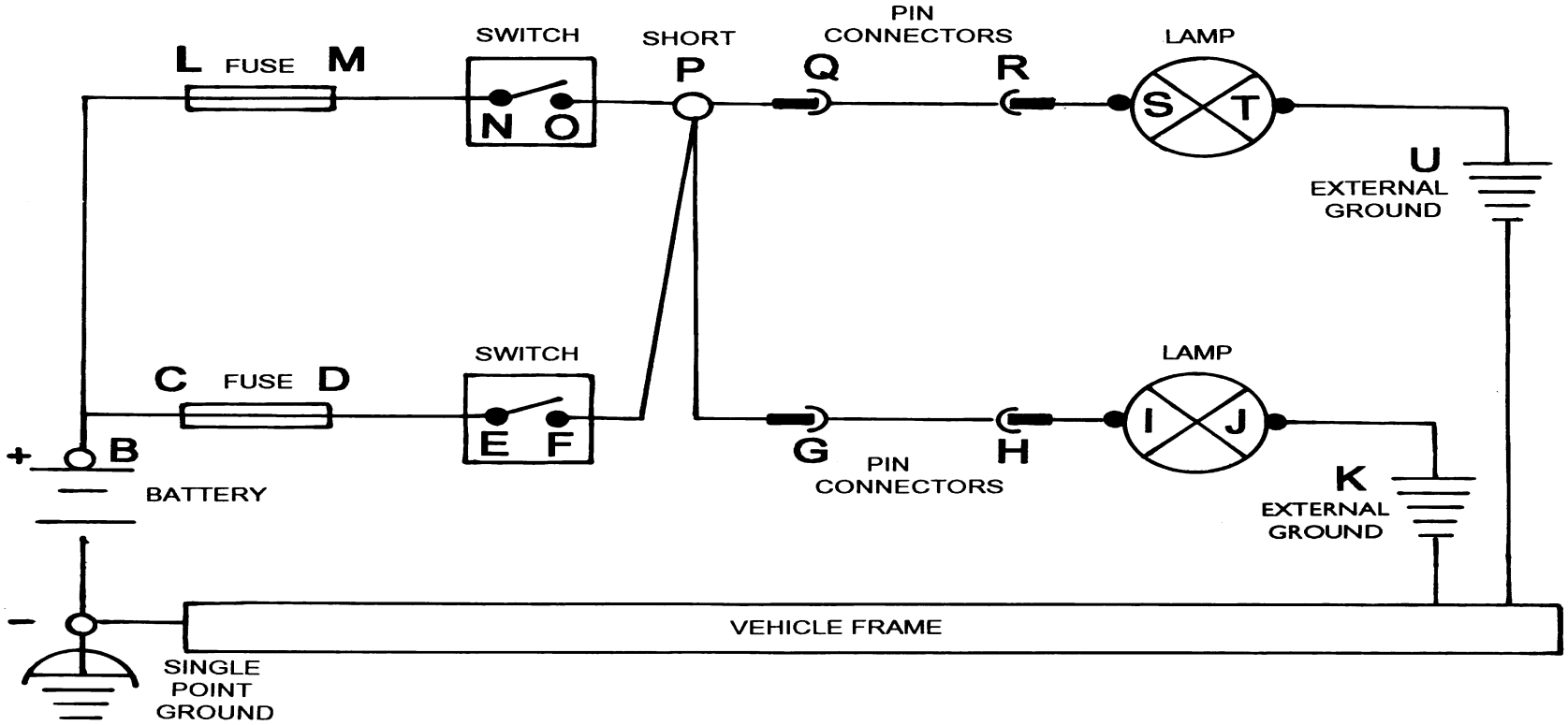
OPEN CIRCUIT

BASIC ELECTRICAL CIRCUIT FAULTS



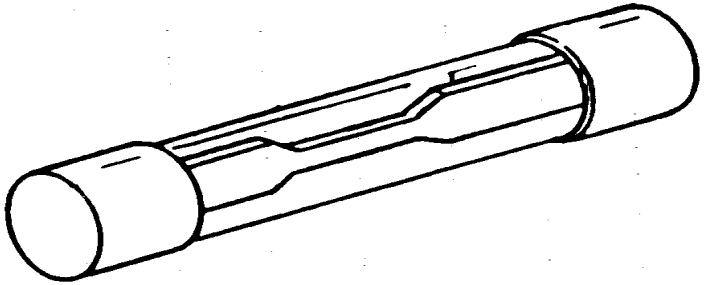
GROUNDED CIRCUIT

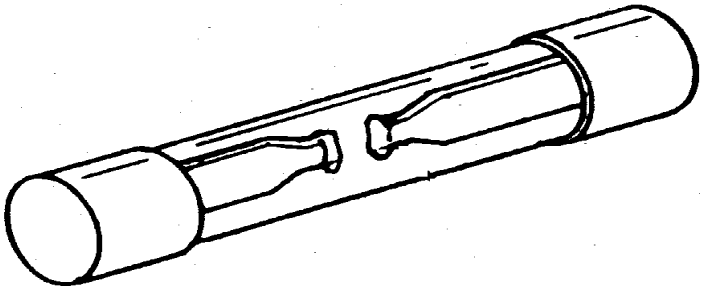
BASIC ELECTRICAL CIRCUIT FAULTS

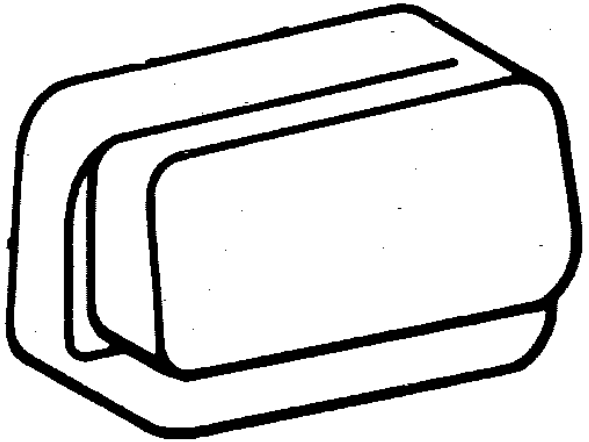


SHORT CIRCUIT

PROTECTION DEVICES



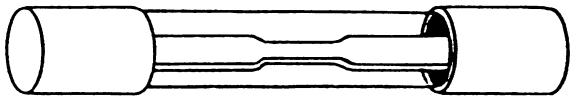




FUSE S

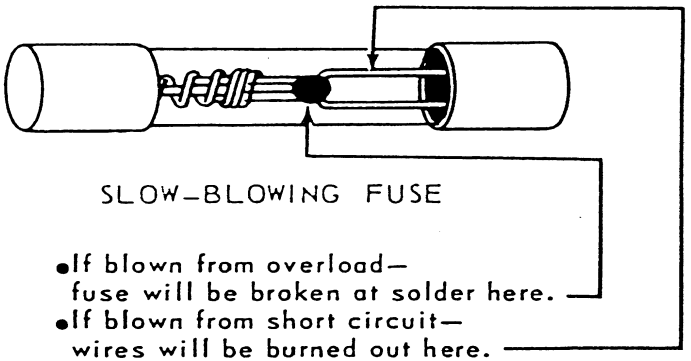
CIRCUIT BREAKERS

FUSES



QUICK–BLOWING FUSE

- If blown from overload–
  glass will be clear.
- If blown from short circuit–
  glass will be dark.



SLOW–BLOWING FUSE

- If blown from overload–
  fuse will be broken at solder here.
- If blown from short circuit–
  wires will be burned out here.

CIRCUIT BREAKERS

REVIEW

1. TYPES OF CIRCUITS
2. TYPES OF WIRING
3. ELECTRICAL COMPONENTS

ACTION: IDENTIFY THE FUNDAMENTALS OF AUTOMOTIVE ELECTRICITY

CONDITIONS: IN A CLASSROOM, GIVEN A STUDY GUIDE

STANDARDS: IDENTIFY THE FUNDAMENTALS OF AUTOMOTIVE ELECTRICITY IN ACORDANCE WITH (IAW) FM 11-60 AND TM 9-8000

SAFETY: NONE

RISK ASSESSMENT: LOW

ENVIRONMENTAL: NONE